Robot Handcontroller

Shown **below** is the PER-Force™ robotic force-reflecting handcontroller, which provides a sense of touch, or "feel," to an operator manipulating robots or other objects. This force simulation, together with a wide range of motion, greatly enhances the efficiency of robotic and computer operations that require manipulation and dynamic control of objects in multi-dimensional space.

The PER-Force handcontroller (Programmable Environment Reality through Force) is the first commercial product of Cybnernet Systems Corporation, Ann Arbor, Michigan, a company formed in 1988 to focus on high technology R&D and derivative products. The handcontroller was originally designed for use aboard Space Station *Freedom*; it was developed under Small Business Innovation Research contracts sponsored by Johnson Space Center.

A ROBOTIC DEVICE DEVELOPED FOR SPACE STATION USE IS NOW A COMMERCIAL PRODUCT

The PER-Force handcontroller is a small backdriveable robot that moves in six degrees of freedom: three linear positions (x, y or z) and three attitudes (roll, pitch and yaw). The operator uses the motorized handle for precise positioning of robots or graphically displayed objects to a given location (x, y or z) and tool angle (roll, pitch, yaw). Manipulation and "feeling" of multi-dimensional objects is accomplished by a host computer — or a robot control system — that reads handcontroller joint position, velocity and force through interface ports.

The handcontroller generates "force feedback" on each axis, using six small brushless DC servo motors. For example, if a robot system is equipped with force sensing devices, the output of the sensors can be used to apply contact forces to the handle, allowing the operator to feel contacts remotely.

More exotic force-reflection operations involve communicating tactile or "virtual" information. An example: When a camera mounted on a robot is used for visual inspection of a surface, the force generating handle can accentuate optically measured defects in the surface by providing a bumpy — rather than smooth — feel to the operator, even though no physical contact actually occurs.

The PER-Force handcontroller has special utility for teleoperations where visibility is limited — murky underwater environments, for example, or areas with obstructions and reduced light, such as underground excavations. There are other robot control applications in research laboratories, hazardous waste handling, the nuclear and utility industries, and in certain manufacturing operations where it is unsafe, impossible or impracticable for humans to touch a worksite directly. ●

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